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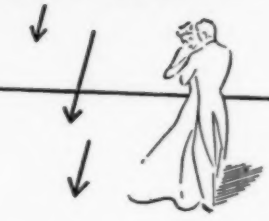

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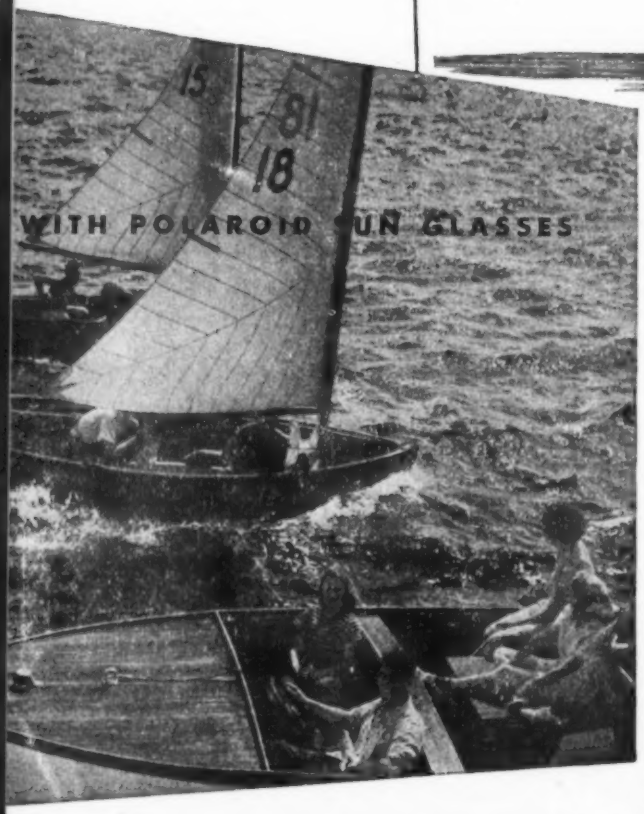

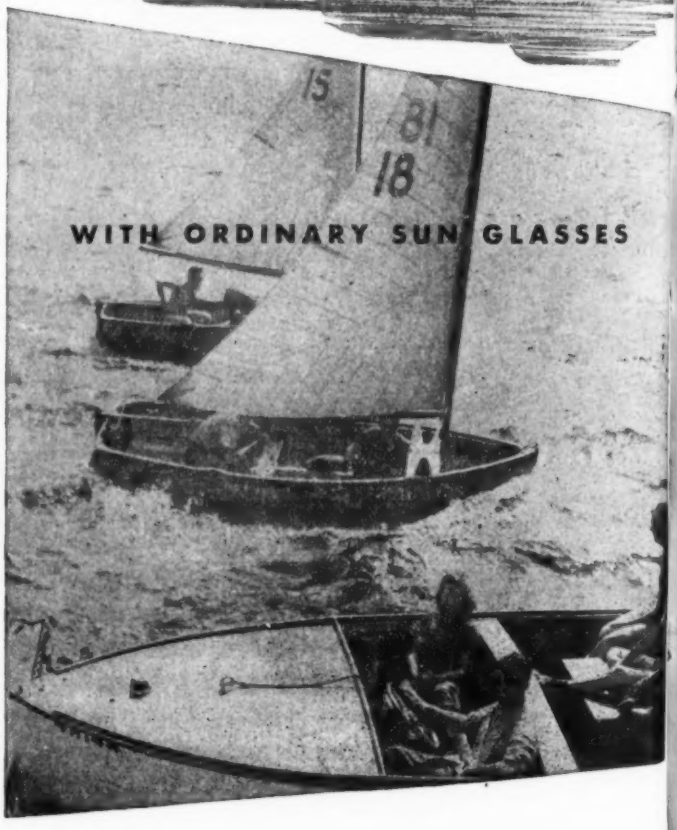

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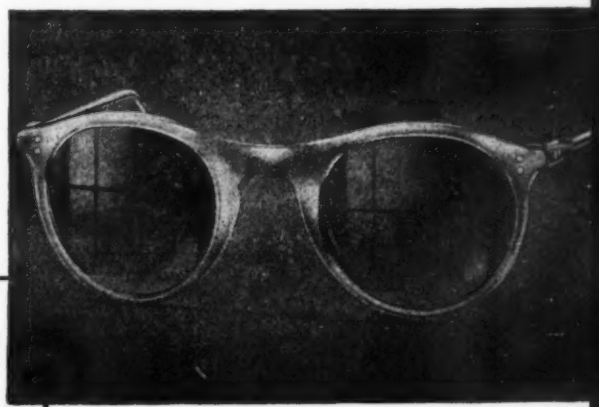

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A NEW METHOD OF SUBJECTIVE REFRACTION AT THE NEAR-POINT*

Matthew Luckiesh and Frank K. Moss
Cleveland, Ohio

Emmetropia is usually defined as the normal condition of the ocular refractive system in which rays of light from distant objects are focused sharply upon the retina; or as expressed by Sheard, it is "that condition of the eye in which, in a state of repose, infinity and the retina are conjugate points." If a complete state of rest were considered essential to the specification of emmetropia, it would follow from the definition that the condition of emmetropia can be revealed only under complete cycloplegia. However, there are adequate reasons for assuming a physiologic rather than a paretic state of rest when defining emmetropia. Such a state of rest might be described as that accompanying binocular fixation at distance in the absence of adequate stimuli for relative accommodation.[1] This viewpoint is somewhat analogous to that expressed by Bielschowsky[2] in discussing heterophoria—"Thus, being unable to determine accurately the absolute position of rest, one must be satisfied to ascertain the relative position; that is, the position of the eyes relative to each other which is displayed after as many of the nervous influences as possible have been eliminated." It is correspondingly assumed, with respect to the accommodative mechanisms, that a satisfactory relative position (as to convergence) is one which closely approximates that involved in normal seeing but yet permits the measurement of the accommodative

*An abridgment of the material presented before the American Academy of Optometry. For publication in the June, 1941, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

state without error due to irrelevant factors. Under these specified conditions for physiologic rest it will be shown that infinity and the retina are not conjugate points but rather that parallel rays of light are focused at a point anterior to the retina in the adult emmetropic eye.

Avoidance of relative accommodation. It may be taken as axiomatic that relative accommodation is preventable through the avoidance of adequate optical stimuli for this function.[3] For example, in the so-called "fogging" method of refraction, all details of the visual field are initially blurred by convex lenses; and in this situation, it is probable that the subject will fail to exercise negative relative accommodation, due to the fact that the retinal image is so blurred as to discourage any effort to see better by the available means. However, as conjugation is approached, the visibility* of all objects within the visual field increases and, con-

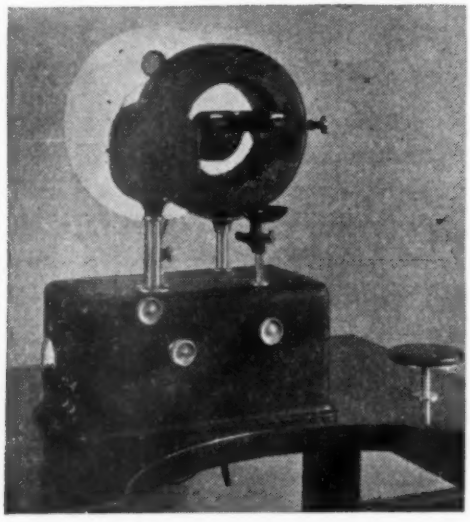

Fig. 1. The Luckiesh-Moss Sensitometer as used in near-point examinations. Within the white circular field are located the test-object and convergence-target. These components of the ensemble are illustrated in Fig. 2.

*In the present discussion, the term *visibility* is used to denote the intensity of a psychophysical stimulus which evokes visual perception and discrimination. This quantity, by definition, depends not only upon the physical characteristics of the object of regard but also upon the efficacy of the visual processes of the observer. If it be specified that all measurements of visibility are to be made with the same test-object, the measured quantity then relates to the efficacy of the visual processes of the observer. Thus maximal visibility will be obtained, in a given case, when the object and the retinae are conjugate. If the refractive power of the system is altered by the addition of ophthalmic lenses, less than maximal visibility (for a given test-object) will result unless such additions are accompanied by compensatory accommodative changes.

comitantly, the stimuli for relative accommodation become stronger. Hence relative accommodation may become functional in the most critical phase of the ocular examination. In recognition of this characteristic, certain biases in the direction of plus power, such as the adding of as much plus power as is possible without materially reducing visual acuity, are deliberately introduced in the refractive techniques in order to obtain satisfactory ophthalmic corrections.

In the sensitometric method of refraction developed by Luckiesh and Moss,[1] the visual efficiency of the subject is determined through the use of brightness-contrast rather than visual-acuity thresholds. This difference in technique is an important one since it permits the determination of the refraction yielding maximal visibility unvitiated by the exercise of relative accommodation in *any* phase of the ocular examination. These measurements are readily made with the Luckiesh-Moss Sensitometer (Fig. 1) when the latter is used under certain prescribed conditions. Since this instrument and technique have been described elsewhere[1,3] only a brief discussion is included here. The sensitometer comprises two colorless circular photographic gradient filters, precise in optical density and diffusion, which may be rotated synchronously before the eyes of the subject in order to bring a standardized test-object (see Fig. 2) to the threshold of visibility. These gradient filters not only alter the apparent brightness of the entire visual field by absorption, but also alter the brightness-contrasts of all objects within the binocular visual field, due to the slightly diffusing character of the filters. Thus threshold conditions are obtained by photometric changes, while the visibility of the single standardized test-object may be expressed in terms of any one of the variables of the threshold stimulus. With this instrument, visibility values are read from a calibrated scale attached to the gradient filters. The method of calibrating this scale and its visual significance have been discussed elsewhere.[4]

If, in the measurement of visibility, the test-object is brought from a sub-threshold condition, to the threshold of visibility by progressively decreasing the density of the filters through which it is viewed, it follows that there can be no optical stimulus for accommodation until the lowest threshold of visibility, involving the mere recognition of the presence of the test-object, is reached. The conditions thus imposed by this procedure are somewhat analogous to those involved in the "fogging" method of refraction except that in our procedures *all* objects within the

entire binocular field (with the exception of an adequately diffuse or blurred convergence-target) are obscured by the filters until the threshold of test-object visibility is reached. Since the visibility of the test-object itself is higher than that of other details of the visual field, there is no adequate stimulus for relative accommodation *throughout* the process of measurement.

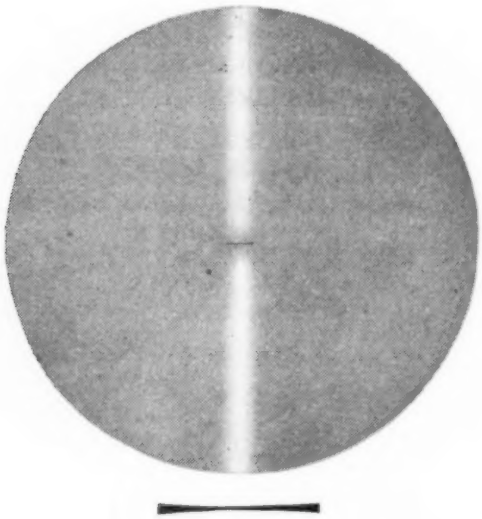

Fig. 2. The visual field, convergence-target and the test-object as used in near-point testing. For purposes of illustration, the horizontal biconcave test-object is shown clearly defined in the gap in the blurred vertical convergence-target. Below this illustration is an enlarged view of the biconcave test-object.

In order to determine refractive states of the eyes at finite distances, it is essential to provide a binocular stimulus for convergence which *per se* will not stimulate the accommodation. This objective is achieved through the addition of a vertical convergence-target (Fig. 2) consisting of a vaguely defined band of diffuse light in the plane of the test-object. It has been shown empirically (see Fig. 3) that such a band of light, whose image lies in parafoveal regions, provides an adequate stimulus for convergence but an inadequate one for relative accommodation.[1] Hence trial lenses of various powers may be placed before the eyes without altering the inherent interlocking relationship between accommodation and convergence. Thus convergence is the controlled factor in the physiologic situation established by these procedures while the excess or deficiency of the refraction is the measured quantity. Under these conditions, it appears

that normal eyes are in as complete a state of physiologic rest as is possible with the maintenance of accurate convergence.

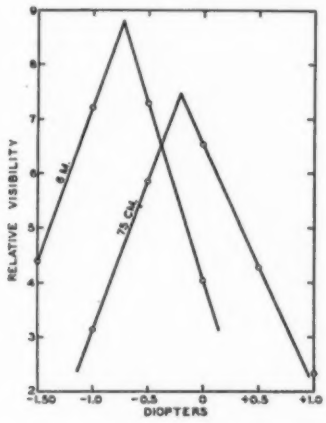

Fig. 3. The relationship between visibility and refraction for fixational distances of 6 meters and 75 centimeters, respectively. The assumption of a linear relationship between these variables, for the dioptric range shown, is justified from a practical viewpoint as will be evident from the detailed data presented in Figs. 4 and 5.

Experimental procedures. The relationships shown in Fig. 3 are typical of those obtained for adult non-presbyopic emmetropic subjects by the sensitometric method of refraction. The essential steps in this method are as follows:

1. A convex cylindrical lens of two diopters or more is placed before one eye with its axis horizontal. The purpose of this lens is to obliterate the image of the horizontal test-object without impairing the vertical convergence-target, and thus to confine the refraction to the other eye.
2. Cylindrical lenses of various positive and negative powers are successively placed before the eye under examination, and several measurements of the visibility of the test-object (a biconcave bar 60 minutes in length) are made with each.
3. The visibilities obtained with the various trial lenses are plotted as shown in Fig. 3 and straight lines are drawn through these points. The resultant graph should be symmetrical about the axis of maximal visibility,—an indication of the avoidance of accommodation. Its apex indicates the refraction which will produce maximal visibility without the exercise of either positive or negative relative accommodation.

Since the same procedures and apparatus are used at all fixational distances, the results are strictly comparable. Hence anomalies in the accommodation-convergence coupling, if present, are clearly revealed.

The refractive state of the emmetropic eye. It will be noted from Fig. 3 that the relationship between visibility and refraction is sym-

metrical about the axis of maximal visibility, and that the latter is indcated with exactness. It follows, therefore, that relative accommodation to the trial lenses was avoided notwithstanding the fact that the accommodative mechanisms were still under nervous control. Furthermore, it has been shown elsewhere,[1] and indicated in Fig. 3, that the avoidance of relative accommodation is complete for various fixational distances between infinity and the near-point. These characteristics of the sensitometric method are not inherent to the usual static and dynamic techniques. Thus the sensitometric method adds to the science of refraction a subjective dynamic test which is at least as significant and precise as present static tests either under normal conditions or under cycloplegia. It should also be recognized that this method does not involve empirical compromises or corrections in any form.

The relationships between visibility and refraction for two so-called emmetropic subjects are presented in detail in Figs. 4 and 5 for a fixational distance of 16 inches (40 cm.). It will be noted that the effects of convex and concave lenses in reducing visibility are practically identical notwithstanding the fact that 2.5 diopters of convergence accommodation were in force during these measurements. It will also be observed that the relationship between visibility and refraction may be represented quite accurately by straight lines within ranges of about one diopter on either side of the point of maximal visibility. Thus it is expedient to confine the sensitometric measurements to this dioptric region. Obviously, the intersection of the two "straight line" portions of the curve, when

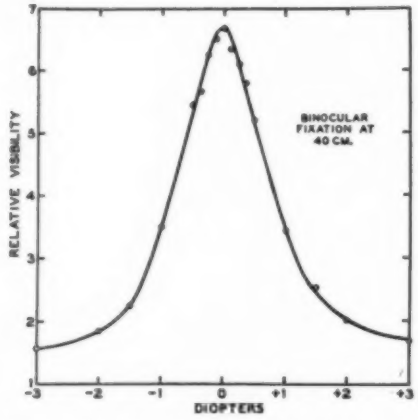

Fig. 4. The detailed relationship between visibility and refraction with binocular fixation at 40 cm. for Subject A. These data are typical of those obtained with emmetropic subjects.

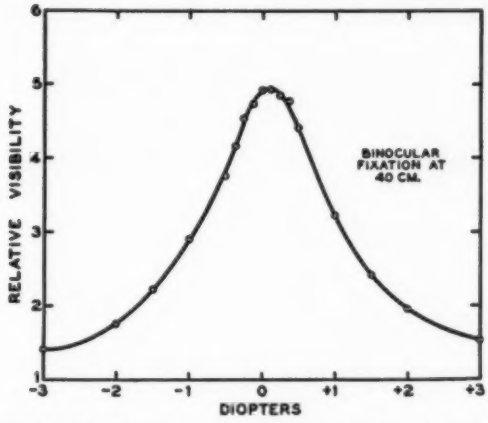

Fig. 5. The relationship between visibility and refraction for Subject B. It will be noted that both subjects are emmetropic at the near-point but that Subject A (Fig. 4) achieves a higher degree of visibility than Subject B.

projected, indicates the refraction which will yield maximal visibility (see Fig. 3). It should also be obvious that this datum can be obtained from a portion of the symmetrical visibility-refraction relationship. This fact facilitates the application of the sensitometric procedures in clinical practice since not more than four points need to be determined. Actually three measurements of visibility will suffice to determine the correct refraction. In this case, the refraction is indicated by the bisector of a line joining points of equal visibility on the "positive" and "negative" branches of the visibility-refraction relation.[1]

The data presented in Fig. 3 and elsewhere[1] indicate that the normal adult non-presbyopic eye requires, on the average, an addition of about ¾ of a diopter of negative power in order to obtain maximal visibility at distance, when relative accommodation is avoided. In other words, the normal unaccommodated adult eye is focused not for infinity, as may be the case under cycloplegia, but for a distance averaging about 1⅓ meters although individuals vary markedly in this respect. Nevertheless, they are presumably able to obtain maximal visibility at distance under normal conditions for seeing, through the exercise of negative relative accommodation from the physiological state of rest. This characteristic may be considered as a functional adaptation[5] to the demands of near-vision. As such it facilitates the shifting of visual fixation from short to long range and *vice versa*.

The indication that the unaccommodated normal adult non-presbyopic eye is focused for some finite distance suggests a possible origin

of some of the complexities encountered in the fogging method of refraction. For example, when the eye is severely fogged with plus power, parallel rays of light are not only focused anterior to the retina due to lens action, but it is also possible that the excessive blur eliminates some compensation by negative relative accommodation. While the progressive reduction in plus power serves to shift the point of focus towards the retina, it may also induce negative relative accommodation which would further move the point of focus towards the retina. Obviously, the latter effect would tend to conceal the exact dioptric power which would correct the ametropia. It is also not improbable that the conception of conjugacy between the retina and a distant point in emmetropia, without a consideration of the possible effects of negative relative accommodation, has led to ambiguity in rationalizing the subjective examination with static retinoscopic tests.

With binocular fixation at 16 inches, it will be noted (Figs. 4 and 5) that maximal visibility is obtained without additional power in the case of these two emmetropic subjects. A similar result was also obtained, on the average, for a group of 20 adult subjects considered to be emmetropic from the viewpoint of the usual ocular examination. On the other hand, when so-called emmetropic subjects of this age-group are examined by dynamic retinoscopy, it is usually found that, on the average, an additional ¾ of a diopter of plus power is required for neutralization of the fundus reflection. This differential is usually described as a "lag of accommodation"[6]. In view of the significance of the sensitometric indication of emmetropia at near, it seems reasonable to assume that (1) the so-called lag of accommodation at this distance does not exist in reality; and (2) that retinoscopic indication of such a differential is an artifact arising from irrelevant factors involved in the procedures of dynamic retinoscopy. It should also be obvious that the use of arbitrary correction-factors in the interpretation of dynamic retinoscopic findings is the least justified in those very cases in which specific knowledge of so-called dynamic functions is most needed. These difficulties are avoided in dynamic sensitometry since the ophthalmic correction corresponds to that which yields maximal visibility.

Emmetropia. The relationships between visibility and refraction indicated by near-point sensitometry, as well as theoretical considerations, suggest the possibility of defining emmetropia in terms of near-point phenomena. Thus emmetropia might be defined as "the condition

of the eyes in which, without compensation by relative accommodation, a given near-point (or range of near-point) and the retinae are conjugate". A fundamental advantage of this specification, in comparison with present specifications in terms of distant-vision, is that the condition of emmetropia is clinically determinable on an absolute basis. This basis is that of maximal visibility rather than some arbitrary degree of visual acuity at distance, such as 20/20. Obviously, the latter criterion introduces ambiguity, as well as empiricism, in present determinations of the normal ocular condition. Furthermore, the attainment of emmetropia for near-vision is usually far more important than emmetropia for distant-vision would be, due to the prevalence, severity and duration of the visual tasks of modern civilization.

The authors acknowledge the assistance of Dr. R. M. Hall, Cleveland, in the preparation of this paper. We are also indebted to S. K. Guth and A. A. Eastman of our Laboratory for their part not only in accumulating the present data but also in the development of these techniques.

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ACCURACY IN DETERMINING THE READING DEPTH*

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In a recent paper[1] an indirect method of determining the reading depth was described. It was assumed in this procedure that the reading position of the line of sight intersected the straight forward position at a point 13 mm. behind the cornea. It is obvious to begin with that this distance is unlikely to be uniform in all individuals. It is proposed therefore in the present paper to investigate the seriousness of any error which might arise from the assumption of a fixed distance. Furthermore, it is proposed to investigate the extent to which the distance from the cornea to the point of intersection does vary from one individual to another. Finally an attempt will be made to compare the results obtained by the previously described method with a more direct method.

EFFECTS OF POSSIBLE VARIATIONS FROM THE ASSUMED POSITION OF THE POINT OF INTERSECTION

In order to carry out this part of the investigation, drawings 4 times the actual size were made for the purpose of determining the effect on the reading depth. A typical drawing is illustrated in Fig. 1. The 6 D. curve ACB represents the front surface of the lens mounted before the eye. Angle theta is the angle between the straight forward and reading positions of the line of sight. The line AB passes through the top and bottom edges of the front surface of the lens. In all the drawings this line was made to assume an angle of 80° with the straight forward position of the line of sight and crossed the line of sight 11 mm. in front of the cornea. The reading depth (CD) is the distance on the curve ACB between the two positions of the line of sight. This distance was determined for various distances of the point of intersection behind the cornea and various values for the angle theta. The results are summarized in Table I.

*Submitted on March 5, 1941 for publication in the June, 1941 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF THE AMERICAN ACADEMY OF OPTOMETRY.

TABLE I

Angle Theta	Reading depths for different distances from the cornea to the intersection of the straight forward and reading positions of the line of sight in mms.				
	11	12	13	14	15
20	8.25	8.50	8.75	9.12	9.50
25	10.25	10.62	11.00	11.37	11.75
30	12.37	12.75	13.37	13.87	14.37
35	14.75	15.12	15.87	16.50	17.12
40	17.25	17.87	18.50	19.25	20.00
45	20.00	20.75	21.75	22.37	23.12

When the average distance of 13 mm. is used in determining the vertical prismatic effect at the reading level in place of the true distance for a particular individual, the error involved is small. In an extreme case in which the point of intersection lies, say, 11 mm. behind the apex of the cornea instead of the assumed 13 mm., and the angle formed by the straight forward and reading position of the line of sight is relatively large, there is an error in the reading depth of only 1.75 mm.

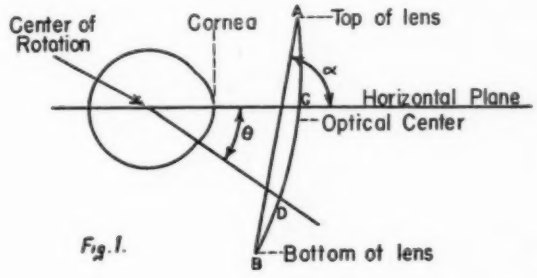


Fig. 1.

It is worthwhile to consider the importance of these data in the matter of calculating vertical imbalance at the reading level induced by anisometropia. Assuming that the optical center falls on the straight forward position of the line of sight, a variation in the reading depth of 1.75 mm. would modify the vertical imbalance only .37△ in cases where the anisometropia in the vertical meridian amounts to 2.00 D. Kehoe[2] has shown that only 1.6% of all persons wearing glasses have a vertical anisometropia of more than 2.00 D. It may be concluded, therefore, that except in this very small percentage of cases the error introduced by assuming a fixed value of 13 mm. for the distance from the cornea to the center of rotation is negligible.

If the various positions of the line of sight intersected at a common point, this might be regarded as a center of rotation.* Unfortunately, all the various positions of the line of sight are apt not to fall at a common point, and hence, the concept of a center of rotation must be treated in an arbitrary way for the problem at hand. It is assumed therefore in a profile drawing of the eye that the intersection of the straight forward and reading position of the line of sight represents the center of rotation. It would not be necessary to refer to this point at all as the center of rotation were it not for the convenience that this is a much shorter designation than the point of intersection of the straight forward and reading positions of the line of sight.

INDIVIDUAL VARIATIONS IN THE POSITION OF THE CENTER OF ROTATION

Another aspect of the problem is to find out by direct experimentation the extent to which the distance from the cornea to the point of intersection varies from one individual to another. The procedure described below gives a direct measure of the distance from the cornea to the intersection of the two positions of the line of sight.

The apparatus is illustrated in Figures 2 and 3. The subject is seated at the instrument with his chin and forehead in the chin rest. This arrangement fixes the position of the head in an erect and stationary position. By means of the adjustable chin support the chin rest can be moved up or down by the patient himself, until he sees the stationary target exactly centered in a vertical direction through the 1 mm. pinhole. The target is a small black circle on a white background, and subtends an angle at the center of the entrance pupil which is slightly less than that subtended by the pinhole. Consequently, though the subject accommodates for the fixation target and the pinhole is only seen as a blurred image, yet the target can be accurately centered through the pinhole.

By means of adjustable gears the entire head rest can be moved to the left or right, or forward and backward. These latter adjustments were made by one of the two operators required to manipulate the instrument. The up and down position of the head was controlled by the patient himself. When the stationary fixation target was lined up with the pinhole, the center of the anterior surface of the cornea was the same height as the center of the telescope. It was a simple procedure for the

*This conception of the center of rotation is fully discussed in Helmholtz's *Physiological Optics*, Vol. 3, 1925, pp. 126-139.

operator then to move the entire head rest forward or backward until the anterior surface of the cornea was coincident with the vertical cross hair in the telescope. This kept all corneas at a fixed distance of 72 mm. from the pinhole. Once these precursory operations had been completed, the

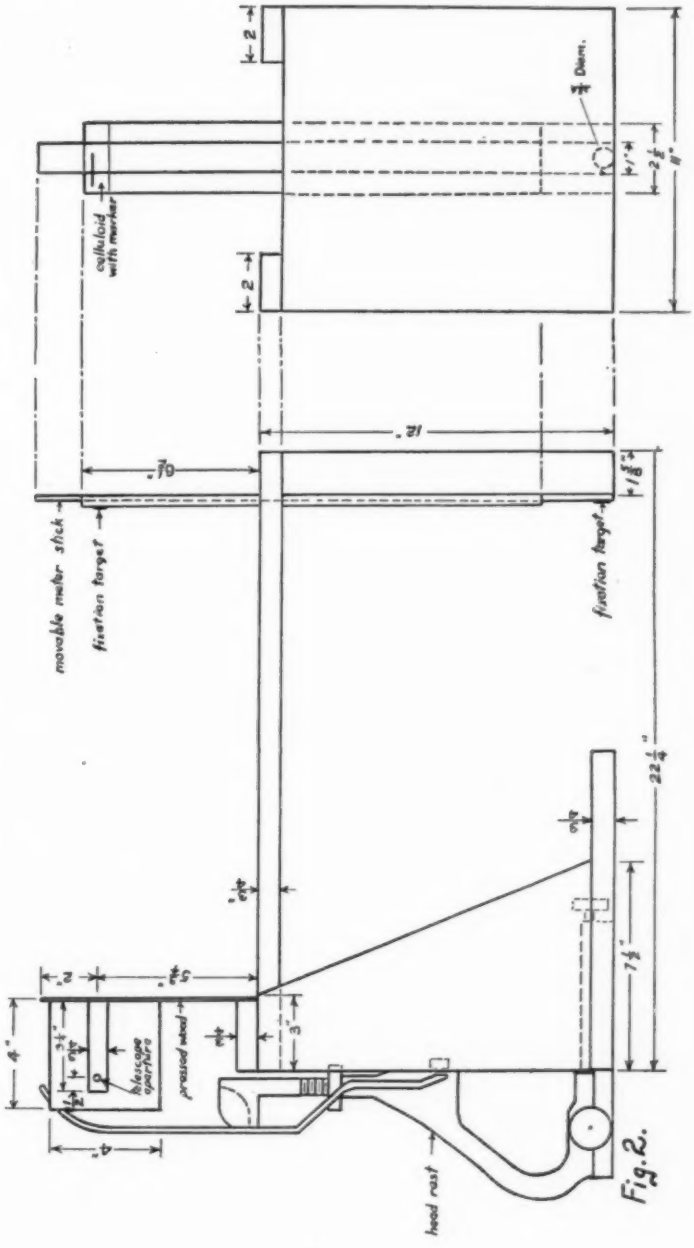
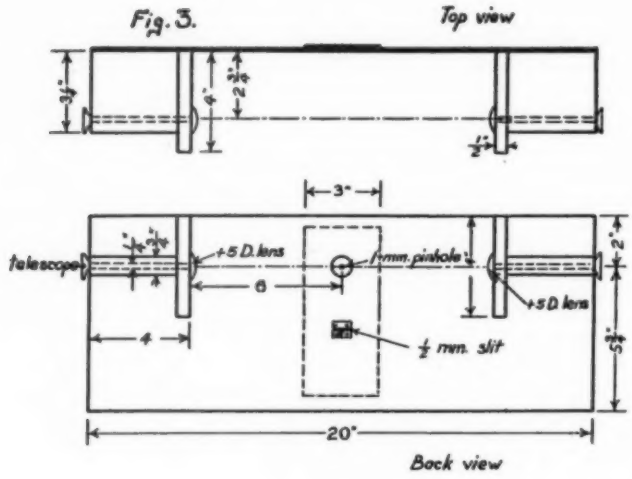


Fig. 2.



subject was then instructed to fixate the movable target through the horizontal slit and signal whether the target appeared above or below the center of the slit. He was also told to shift his fixation alternately from the stationary to the movable target, and persist in so doing throughout the various trials. If the subject cannot fixate the target through the slit, it is moved up or down until it is seen exactly centered with respect to the slit. The only measurement that needs to be made is the distance of the movable target below the fixed target. This distance (Z) (Fig. 4) can be read directly from the meter stick by means of the marker on the celluloid. At least five such settings were made on each subject and the average computed.

The mathematical computation of the distance from the cornea to the center of rotation is based on the simple geometric relationship of similar triangles (Fig. 4). Since the distance from the pinhole to the stationary target, and the distance from the pinhole to the horizontal slit are fixed with respect to the instrument, various values of Z can be substituted in the following equation, for the determination of X:

$$\frac{45.10}{Z} = \frac{X}{6.3}, \text{ or } X = \frac{6.3 \times 45.10}{Z}$$

Since the distance from the anterior surface of the cornea to the pinhole is constant at 7.2, it is necessary to subtract this value from the computed value of X. This gives a measure of the distance of the center of rotation from the anterior surface of the cornea in cms.

TABLE II

	O. D.				O. S.			
	Mean Z cms.	Trials	Av. Dev. Trials cms.	C of R mms.	Mean Z cms.	Trials	Av. Dev. Trials cms.	C of R mms.
1	39.81	6	.042	12.77	39.35	6	.085	12.95
2	38.60	6	.06	15.95	38.80	8	.08	14.42
3	40.16	9	.44	12.85	40.17	8	.101	12.86
4	39.17	8	.088	14.42	38.79	9	.07	14.43
5	38.90	7	.105	15.15	39.04	7	.042	13.77
6	39.63	5	.042	13.15	39.38	8	.092	12.90
7	39.34	7	.041	14.0	39.28	7	.021	13.17
8	38.49	9	.166	16.27	38.44	8	.098	15.42
9	39.26	5	.112	14.20	38.94	5	.043	14.0
10	38.70	6	.06	15.70	38.80	8	.051	14.41
11	38.80	8	.18	15.42	38.34	6	.041	15.68
12	38.52	8	.102	16.18	39.02	8	.107	13.83
13	39.33	7	.057	14.02	38.91	7	.071	14.12
14	39.78	7	.051	12.87	39.62	5	.038	12.25
15	39.01	8	.070	14.85	39.06	7	.087	13.72
16	39.16	7	.057	14.46	38.58	7	.111	15.02
17	38.71	6	.14	16.68	38.59	6	.088	17.0

In this investigation the center of rotation was determined for 17 subjects. The only limitation on their selection, was that they be able to see the fixation targets clearly. This eliminated high myopes, and those individuals with high astigmatism. In making these measurements, the subjects did not wear their refractive corrections.

The mean setting of Z, the average deviation of the settings from the mean, and the computed center of rotation for the mean of the trials for each subject are tabulated in Table II.

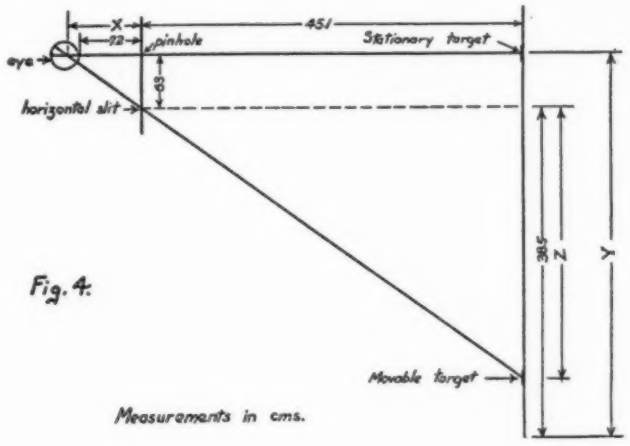
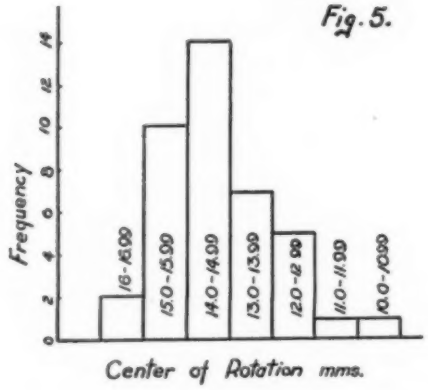


Fig. 4.

In the measurement of Z it requires an approximate 2 mm. variation to produce a .5 mm. variation in the calculation of the center of rotation. In only one of the cases in Table II did the average deviation exceed this limit. The mean of the center of rotation for the right eye was 14.58 mm., and for the left 13.997 mm. The mean for both right and left eyes taken together was 14.288 mm. The average deviation of the center of rotation from the mean of 34 eyes measured was 1.00 mm. The standard deviation† was 1.226 mm.

Figure 5 is a histogram illustrating the frequency distribution of the measurements of the distance from the cornea to the center of rotation. It reaches its maximum frequency between 14.00 and 14.99 mm., which also corresponds to the mean of the measurements of the two eyes.



It is important to note that in measuring the distance Z in order to calculate the center of rotation, small variations were encountered in successive trials. With each measurement, the highest degree of accuracy was exercised to keep the distance from the anterior surface of the cornea to the pinhole constant. Likewise, the patient was instructed to use an equal degree of caution and accuracy in centering the fixation targets. For these reasons the question may be raised as to how these variations are to be explained. The psychological factors of attention undoubtedly play an important role. Likewise the subjective judgment of the subject in centering the stationary and movable target contributed to the varying deviations of the successive trials.

† ±1 standard deviation includes 34.13% of the cases on either side of the mean, under the normal probability curve.

Aside from these various psychological factors which enter into each trial there are a number of physiological factors concerned. Pulse and breathing cause head movements.[6] Besides the fixation movements resulting from pulse and respiration, the eyes suffer passive displacement with every movement of the head and body. Of equal significance is the anteroposterior movements of the eye due to the varying width of the palpebral fissure which were described by Mueller and Donders.[7]

The location of the centers of rotation of the 17 subjects used in this investigation when averaged conforms rather closely to the values of previous averages. Such averages have ranged from 12.9 mm., as found by Weiss in 1875, to 15 mm., as determined by George, Toren, and Lowell in 1923.[4] Donders, Volkmann, Berlin and others found intermediate values.[3]

COMPARISON OF THE INDIRECT METHOD OF DETERMINING THE READING DEPTH WITH A MORE DIRECT METHOD

In order to further demonstrate the validity of the indirect method described in the previous paper for measuring the reading depth, data obtained with this method were compared with reading depths measured by a more direct method.

In obtaining data for making this comparison a stereotyped procedure was followed by each subject. First a pair of plano glasses marked with white horizontal lines 1 mm. apart, were fitted, having the necessary bridge and eyesize, and the correct temple lengths. The lines facilitated measuring the reading depth by the direct method, as will be described later. The subject then had a photograph taken with the topometer.[1]

A second photograph was then taken with an instrument designed to make a direct and permanent record of the reading depth. This instrument consisted essentially of a camera which was mounted and movable on a vertical metal arc of .5 meters radius. The arc was mounted to a floor stand which could be moved forward or backward. The arc could also be raised or lowered by the simple adjustment of a metal clamp. The camera used was a Korelle Reflex, with a 2.8 lens.

When a photograph was to be taken the center of rotation of the arc was approximated at the center of rotation of the eye. The subject was given a reading card in which a circular hole, the size of the camera shutter, had been cut out. Encircled about this aperture were ordinary

20/50 Snellen type. He was instructed to hold the card in his normal reading posture. The camera was then adjusted, up or down on the arc, until the entrance aperture of the camera was coincident with the hole in the reading card. A photograph was taken with the camera on the arc.

Simultaneously with the taking of this photograph another one was taken with a camera situated two meters laterally to the plane passing through the median sagittal section of the subject's head. It was on a level with, and directly opposite, the center of rotation of the subject's eyes. With this latter photograph, a permanent side view record was made of the tilt of the subject's face plane, and the depression of his line of sight in his normal reading posture.

The topometric photograph was utilized in both the direct and the indirect measurement of the reading depth. The center of the pupil behind each lens in this photograph represents the point on the lens traversed by the line of sight when perpendicular to the face plane and can be read directly from the white lines on the lens. Analogously, the point on the lens traversed by the reading position of the line of sight can be secured from the photograph which is taken with the camera on the circular arc. The distance between the two points gives a direct measure of the reading depth.

Likewise, from the topometer photograph, the necessary measurements for the indirect determination of the reading depth can be secured.[1] These are:

1. The pitch of the lenses; that is, the tilt of the lenses from the primary horizontal plane. This is angle alpha in Fig. 1.
2. The distance of the line connecting the top and bottom of the anterior surface of the lens, from the cornea measured along the straight forward positon of the line of sight.
3. AC and CB (Fig. 1). The reading depth is measured from C on the anterior surface of the lens, CD being the reading depth.

It is likewise necessary to know angle theta (Fig. 1). It was possible to measure it from the photographs since in the topometric record the face plane was vertical and the lines of sight horizontal; and in the side view photographs, the line connecting the hole in the reading card and the approximated center of rotation of the eye, represents the line of sight in the reading position. The angle (theta) between the line of sight in this position, and when perpendicular to the face plane, is the depression of the line of sight in the subject's normal reading posture.

TABLE III

No.	Pitch of lenses Degrees		Cornea to spectacle plane mms.		Center of Rotation mms.		Angle Theta Degrees	Direct measure of reading depth mms.		Calculated reading depth mms.	
	OD	OS	OD	OS	OD	OS		OD	OS	OD	OS
1	85.6	86.5	10	10.8	12.77	12.95	29.8	10.5	10.2	13.7	14.3
2	83.2	83.2	10.5	10.5	15.95	14.42	34.5	16.4	16.7	17.9	17.0
3	78.0	77.5	7.0	8.5	12.85	12.86	34.5	12.5	13.0	13.3	14.7
4	84.2	84.4	11.1	13.5	14.42	14.43	21.5	11.0	11.0	10.5	11.5
5	82.0	79.0	11.2	11.2	15.15	13.77	39.5	18.0	16.8	20.3	19.1
6	79.5	79.5	17.0	14.5	13.15	12.90	30.5	17.8	16.7	17.4	15.9
7	81	84.5	11.1	9.8	14.0	13.17	23.7	12.5	12.0	11.2	10.4
8	83.5	83.5	5.3	6.2	16.27	15.42	24.2	8.0	8.5	10.0	10.0
9	89.5	89.5	9.7	10.6	14.20	14.0	30.0	13.0	13.5	14.6	15.0
10	78.4	77.8	9.0	9.0	15.70	14.41	33.5	13.5	13.5	15.8	15.1
11	87.0	87.3	8.0	11.0	15.42	15.68	34.0	14.8	14.8	16.3	18.4
12	80.2	82.7	8.0	9.8	16.18	13.83	25.5	11.5	9.8	11.7	11.3
13	78.3	79.8	12.5	11.2	14.02	14.12	32.8	16.0	15.25	16.4	15.8
14	89	89	13.0	13.2	12.87	12.25	31.2	13.6	14.6	16.5	16.3
15	78.5	77	9.2	11.0	14.85	13.72	30.0	13.0	13.0	13.8	13.7
16	68.2	69	11.5	11.5	14.46	15.02	42.5	18.5	19.5	19.4	20.2
17	80.0	80.0	12.0	11.0	15.68	15.00	38.0	16.7	16.2	20.5	19.5
				ΣX	247.94	237.95	535.7	237.3	235.0	259.3	258.2
				M	14.58	14.00	31.5°	13.96	13.83	15.25	15.10 mms.

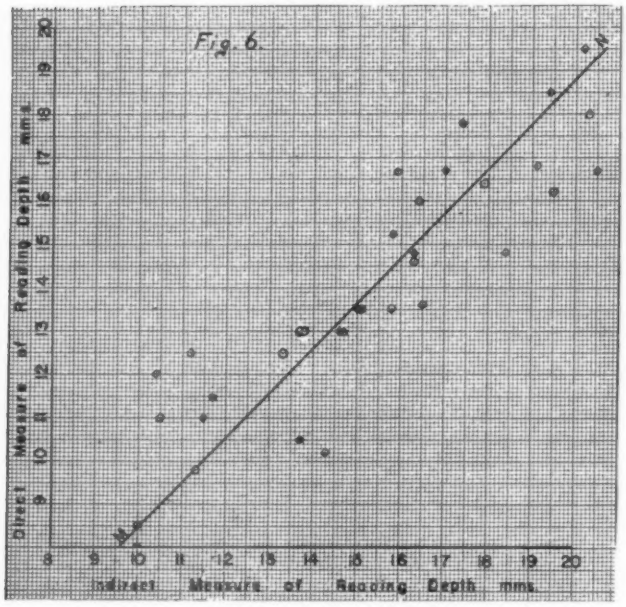
The raw data and the reading depths determined by the two methods are systematically outlined in Table III. The same subjects who served for the measurement of the center of rotation were again used in this portion of the experiment. The measure of their centers of rotation was utilized in the calculation of the reading depth.

Fig. 6 represents a graphic description of the quantitative relation between the calculated and the direct measure of the reading depth. The straight line (MN) was computed by the standard statistical method to determine its position and slope.[5]

The validity coefficient of these two methods is +.897 (*,[5]). The standard deviation of the indirect method about the regression line MN in Figure 6 is ±1.32 mm. This states that in 68.24% of the cases the indirect measure ought not to vary from the direct measure more than ±1.32 mm.

The mean of the direct measure of the reading depth O.D. and O.S. was 13.89 mm., while the indirect was 15.22 mm. The variation between these two means cannot be explained solely as chance. To expound this discrepancy is beyond the scope of the present paper.

*Validity coefficient is defined as the validness of one test as tried by an entirely different method. +.9 and over, indicates a very close relationship and a very high degree of dependence between the variables.



Suffice it to suggest, that the lenses used in the direct method produce, by virtue of their thickness, a displacement and slight deviation of the rays of light passing from the iris, through the lenses, and eventually impinging upon the photographic film. No allowance is made for this in the indirect method.

SUMMARY

In this paper, it has been attempted to determine the validity of a technique which was described in a previous paper for measuring the vertical prismatic effect at the reading level. Since a prerequisite for the determination of the reading depth by this technique is a measure of the center of rotation in the vertical meridian, it was necessary to measure it by a specially devised technique.

To test the validity of this indirect method a direct measure of the reading depth was made. The validity coefficient of the direct and indirect methods was found to be +.897, statistically verifying the computation of the reading depth by the indirect method. The standard deviation of the variations of the indirect from the direct measure of the reading depth was ±1.32 mm.

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DINITROPHENOL AND ITS EFFECTS UPON THE REFRACTION AND TRANSPARENCY OF THE CRYSTALLINE LENS*

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One of the newer types of preventable cataract (one that has caused no little chagrin and embarrassment to some members of the medical profession) is that caused by dinitrophenol—a drug taken by people who are excessively fat for the reduction of body weight.

Although it is capable of producing many serious changes in different organs of the body, it is because of its profound effects upon the eyes that optometrists are particularly interested in dinitrophenol. Due to widespread publicity, laymen, too, have evinced much interest; and in more than one section of the country an indignant citizenry has already passed laws and regulations controlling the dispensing of this medicament.

Physicians have already been warned many times in professional literature about the unfortunate and unpredictable effects of dinitrophenol; and if the careless and indiscriminate sale and use of this dangerous drug persists, some modicum of warning and protection should be offered to the laity directly.

The commercial development and public exploitation of dinitrophenol at the expense of the comfort, health, and sight of hundreds of unsuspecting people is, indeed, a black and unsavory page in the contemporary record of therapeutics. It serves as a warning to every too easily influenced and naive professional man, by illustrating the dangers of introducing a new and imperfectly understood therapeutic agent before it has been thoroughly tried and tested, and before its various side reactions have been extensively studied and cataloged.

Although it is true that the drug has been included in about two dozen patent medicines indiscriminately sold in drug and department

*An abridgment of the material presented before the American Academy of Optometry. For publication in the June, 1941, issue of THE AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

stores for reducing body weight, it is still being prescribed in its pure chemical form by many physicians. In fact, most of the cases of dinitrophenol cataracts I have seen were individuals who took the medicine under the direction of a physician. On the other hand, it should be noted that the drug has not received the approval of the Council on Pharmacy and Chemistry, nor is it listed in the United States Pharmacopea.

The American public is apparently unaware of the utter lack of protection afforded by our present food and drug laws. With an unconcern that repeatedly reaches tragic proportions, the average American citizen apathetically permits his very life to be placed in constant jeopardy by blind faith and unwarranted confidence in his vague and exalted conceptions of modern scientific attainment which he mistakenly assumes to be the basis for the laws which protect him. Certainly it is reasonable to expect that food and drug laws should have some scientific basis, but unfortunately they usually do not. The old Roman commercial principal of *caveat emptor** still prevails. Modern science has not yet conquered ignorance and greed. It has no control whatever over the personal, selfish, and biased commercial activities of certain human parasites, who grow fat upon the infirmities, frailties and credulities of unfortunate and ailing men and women, by blatantly advertising miracles of quasi-scientific discovery, but entirely ignoring the dangers that would be readily revealed by real scientific methods of investigation.

It was due to a similar Machiavellian policy and diabolical activity that citizens of the southwest, in 1930, were blinded, paralyzed, and killed by imbibing concoctions of Jamaica ginger. And less than a year ago over 90 persons met death by taking a new and untried "Elixir." What blacker examples of the glaring lack of protection afforded by present laws!

When dinitrophenol was introduced as an "anti-fat," it was not a new and unknown chemical compound. As far back as 1885 studies on the nitrophenols had revealed its pharmacologic and toxic actions on animals. Interest was revived during the world war when the many and varied poisoning effects of the nitrophenols on munition workers in France were extensively studied and recorded in scientific literature.

In 1933 dinitrophenol was first introduced to the medical profession as a metabolic stimulant. About a year after its introduction reports began to appear in medical literature on the development of cataracts in

*Let the buyer beware.

individuals who had taken dinitrophenol. Reports of other toxic manifestations appeared concurrently and ranged all the way from mild skin rashes to terrible and fatal forms of poisoning for which there are no known antidotes.

PHARMACOLOGY

Dinitrophenol is a yellow crystalline powder readily soluble in most fluids. In solution it rapidly undergoes decomposition. It may be dispensed in capsules or in tablet form. In some cases it is prescribed in its pure form and in others it is mixed with other medicaments.

The main pharmacologic action of dinitrophenol is an increase in tissue metabolism. In moderate doses there is an increase in the basal metabolic rate of 20 to 30 per cent within the first hour after ingestion. As the drug is continued in the same dosage there is a slight additional rise until a maximum increase of approximately 40 per cent is reached on the fourth day. When the medication is discontinued the basal metabolic rate returns to the initial level in three to fourteen days. While taking the drug the patient experiences a slight flushing of the skin, a feeling of warmth, an increased tendency to perspire, and a tendency to breathe more deeply.

The increased body metabolism involves chiefly the utilization of fat and practically no carbohydrates or protein. The fat is broken down completely and in accordance with our physiologic conceptions of normal fat metabolism. There is no increase in fatty acid concentration in the blood and no ketone bodies are found in the urine. In this particular respect dinitrophenol is certainly an excellent drug for it speeds up metabolism wholly at the expense of body fat and yet does not create an acidosis. It is apparently an ideal drug for the reduction of body weight and were it not for its various toxic effects it would undoubtedly be a great boon to the control of obesity engendered by modern soft and sedentary life.

During the ingestion of dinitrophenol the increased tissue metabolism requires a marked increase in oxygen consumption. Therapeutic doses produce slight changes in the composition of the blood plasma. There is an increase in chlorides, a decrease in bicarbonate concentration, but practically no change whatever in hydrogen concentration, calcium, phosphorous, or nitrogen.

Unlike thyroxin or thyroid gland extract, which is also a metabolic stimulant, dinitrophenol does not accelerate the metamorphosis of

tadpoles. This biologic reaction affecting the developmental processes which is so characteristic of thyroid gland is entirely lacking in the synthetic chemical, dinitrophenol.

So much for the pharmacological reactions of dinitrophenol. Now let us turn our attention to the more important aspects of its toxicity.

TOXICITY

For a drug manifesting such remarkably selective reactions on fat metabolism as does dinitrophenol, its toxic effects come as a distinct disappointment. Dramatically, the drug takes on a "Dr. Jekyl-Mr. Hyde" aspect, producing remarkably beneficial results in some cases of obesity, and producing heinous and widespread destruction in the organs of others less fortunate in their individual reactions to it.

It is this wide range of individual variation in the reaction to dinitrophenol that makes its effects so unpredictable. It is this same variation in the individual reaction to the drug that makes a reliable determination of a moderate or average therapeutic dosage an impossibility. Actual reports show that amounts of dinitrophenol in grams per unit of body weight which produce the desired reduction of body weight in one individual may cause widespread and serious poisonous effects in another. These facts were recognized soon after the chemical was introduced as a therapeutic agent. It was hoped, however, that some method could be discovered for determining just how each individual would react to dinitrophenol before it was prescribed for internal use. Various methods of determining the sensitivity of an individual by skin tests were tried but none proved satisfactory. And even today the question of individual sensitivity to the drug remains entirely unsettled. Every individual who takes dinitrophenol is therefore subjected to definite risks of toxicity. And the chances, based on actual statistics, of suffering from such a toxic reaction are approximately one in four or 25 per cent.

Soon after ingestion and as soon as it enters into solution in the body fluids, dinitrophenol undergoes chemical decomposition into reduction derivatives of varying complexities. One of these derivatives, amino —2 nitro—4 phenol, appears in large quantities in the urine of individuals suffering from dinitrophenol poisoning. The detection of this particular reduction product is therefore used as the basis of a urinary test for dinitrophenol poisoning. It is known as the Derrien test but it is not infallible and cases of dinitrophenol poisoning have occurred in which the test was negative. The test is therefore of limited value in a positive

way; but when negative, it is not to be taken as conclusive evidence that the individual is not suffering from dinitrophenol poisoning.

Careful study has failed to reveal any impairment of liver or heart function by dinitrophenol in the majority of cases when taken in moderate therapeutic dosage.

When therapeutic dosage is exceeded the first clinical effects noted are those of increased heat production. The individual becomes uncomfortably warm, perspires freely, and experiences a sensation of suffocation. Drenching night sweats are common among those who develop toxic reactions. The extent of elevation of body temperature, or fever, even serves as a good clinical index to the degree of toxicity. In general, the oral temperature should not be permitted to exceed 99.2° F. When this temperature is exceeded the dangers of a toxic reaction are markedly increased.

One of the outstanding peculiarities of dinitrophenol poisoning is the variety of different initial toxic reactions that may occur. In this way it differs materially from such poisons as arsenic, mercury, lead, strychnine, and cyanide; all of which present fairly constant and unvarying clinical pictures and each producing the same group of symptoms in every individual poisoned by it.

Of the many toxic effects of dinitrophenol the most frequently encountered is an eruption and itching of the skin which occurs in over 20 per cent of individuals taking dinitrophenol. But even the character of this skin rash is inconstant. It may resemble the rash of measles, or that of smallpox or scarlet fever; or it may appear as an attack of hives. It has also been known to cause baldness. Horrible death has occurred from dermatitis exfoliativa—a disease in which the skin becomes red, inflamed and sloughs off in huge sheets leaving raw, bleeding, infected surfaces. This seriously interferes with the heat regulating mechanism of the body and is invariably fatal.

Among the many other toxic manifestations of dinitrophenol are cataracts, headaches, localized pains, nervousness, liver disorders, neuritis, menstrual disorders, asthma, allergy, swellings of the hands and feet, etc.

One of the most serious general effects of dinitrophenol is the toxic effect on the blood. In this particular respect, dinitrophenol is similar to other toxic chemicals which contain the benzene-ring in their molecular structures. The result of this type of poisoning is one of the most dreaded diseases that has appeared exclusively in modern times—agranulocytic

angina. As a result of the toxic effect of the benzene-ring the white blood cells disappear from the circulating blood leaving the body with no defense mechanism whatever against infection. At the same time the throat becomes ulcerated or even gangrenous and another horrible form of death ensues. Any patient who is given any therapeutic agent containing the benzene-ring in a loose chemical structure should be repeatedly and carefully examined in regard to the composition of his blood. White blood cell counts and a microscopic analysis of the composition of his blood should be made at frequent intervals.

The excessive sweating produced by the accelerated metabolic rate also predisposes the individual taking dinitrophenol to colds, sinusitis, bronchitis, laryngitis, tonsillitis, and otitis media. All of these conditions occur more frequently in those taking dinitrophenol than in those who do not.

Out of the total number of patients who are given dinitrophenol it is estimated that approximately 25 per cent suffer some type of toxic reaction.

If dinitrophenol is taken at intervals of 24 hours or less there is a rapid development of tolerance so that the dosage must be progressively increased in order to induce a steady and continuous loss of weight. This tolerance is quite temporary in character and is completely lost within two weeks after the drug is discontinued. When administration is later resumed it must be in much smaller dosage than when discontinued. If the drug is taken at longer intervals of three to four days no tolerance at all develops.

The serious forms of acute dinitrophenol poisoning are exceedingly dangerous because there is no known specific antidote. Treatment consists of supporting the life and vital forces of the patient and maintaining his strength in the hope that the spark of life will outlast the destructive and vitiating effects of the poisonous drug. In such cases attempts are also made to accelerate the emergence of white blood cells into the circulating blood from the bone marrow; but unfortunately medical science has not yet devised any very successful or reliable means of accomplishing this.

OCULAR CHANGES

Although the various toxic effects mentioned above are of considerable interest, the real concern of the optometrist lies in the effects of reducing cures upon the refraction and transparency of the crystalline lens.

Figures 1 and 2. Dr. Marvin J. Blaess.

Photographs of right and left eyes of young woman, 32 years of age, with reducing-cure cataracts showing typical appearance. Vision in each eye is reduced to light perception.

It is estimated that only about 1 per cent of all individuals who take dinitrophenol eventually develop cataracts. However, such statistics or estimates are quite unreliable because dinitrophenol has been dispensed under many trade names which make its real nature, in many cases, unrecognizable. The value of such statistics are further depreciated by the wide variance in the period of time between the ingestion of the reducing cure and the appearance of the lens opacity. Helminen reports five cases in which the cataracts developed seven to fourteen months after conclusion of the reducing cure. I saw one case in which the visual acuity declined from normal to merely light perception in two and one-half months after taking the reducing medicine; and in another case useful vision was not lost until two years after ingestion of dinitrophenol.

Because of its widespread use and the possibility of remote effects

long after it has been discontinued, it has been predicted that a marked increase in the incidence of dinitrophenol cataracts may be expected in the immediate future.

In an individual who has undergone a marked and rapid loss of weight from a reducing medicine, a sudden increase in hyperopia, or a decrease in a pre-existent myopia, is a harbinger of loss of the transparency of that individual's crystalline lens. By some, this development of hyperopia is regarded as the result of tissue dehydration from the excessive sweating and increased metabolism which these individuals experience. Every individual I have seen suffering from reducing cure cataracts has experienced this increased tendency to perspire while taking the medicine. Some even perspire at night during their sleep. Personally, I am not at all convinced that dehydration alone is the inciting factor in the formation of cataracts. I have seen many dehydrated patients who have not taken dinitrophenol and have never developed cataracts.

The increase in hyperopia may be a very transient one and in cases where the lens changes occur rapidly it may be entirely overlooked. In one of my cases the hyperopia increased one diopter over a period of a year and a half and then rapidly decreased by three diopters in a period of four months as the eyes changed from hyperopia to myopia. This development of myopia is one of the secondary refractive changes that occur in these patients destined to develop cataracts. After the initial increase in hyperopia there is also a marked loss of accommodative ability and usually at the same time the first lens opacities become visible as a clouding in the posterior cortex.

During all these changes in the refraction, the ophthalmometer readings remain unchanged. This is of considerable significance for it indicates that the refractive changes that occur are of lenticular origin.

After these early changes which may occur rapidly in some cases or more slowly in others, there is usually a gradual decline in the visual acuity paralleled by an increasing loss of transparency of the crystalline lens. Usually there is a rapid autolysis of the lens fibres. A wide splitting of the main sutures is often visible with oblique illumination in the early stages of the cataract formation; and with the slit-lamp varying degrees of lamellar splitting are easily discernible. Vacuoles of varying size and number are usually also visible in the anterior subcapsular zone. The

entire lens shows a marked increase in thickness during this stage. Often the anterior chamber becomes very shallow as the iris and intumescent lens encroach upon it. During this stage the intraocular tension is usually in the lower range of normal, i.e., 15 to 20 (Schiotz). The instillation of a mydriatic in this stage frequently results in a marked and rapid increase in the intraocular tension as the drainage channels are further obstructed by the dilating iris.

Eventually the lens fibres break down and subcapsular fluid spaces of various sizes and with ragged irregular borders can be made out with the bio-microscope. The fluid in these spaces and in the widened suture lines remains clear, colorless and optically empty for some time. In an occasional case I have been able to view the fundus through the widened suture lines when all other portions of the lens were quite opaque. Eventually, depending upon the extent of disintegration of the lens fibres, this fluid loses its transparency and becomes cloudy and finally milky in appearance. There may be slight or no indication of nuclear sclerosis.

In some cases the anterior capsule remains thin and transparent and in others it becomes translucent and its surface takes on a roughened fuzzy appearance.

If the cataract is permitted to remain in the eye and if no other complication develops there is a gradual receding of the swelling in the lens. The fluid spaces gradually disappear and the lens becomes thinner and more compact. Sclerosis of the central portion usually develops more rapidly than in a normal lens in the months that follow and the patient seldom experiences any improvement in vision.

The exact mechanism by which reducing cures act as specific tissue poisons may not be clearly understood but there can be little doubt as to the effects produced by them upon the crystalline lenses of certain individuals.

SURGICAL REMOVAL OF DINITROPHENOL CATARACTS

My experience with reducing-cure cataracts has convinced me that the method of choice for removing them depends upon the stage of development and upon other varying circumstances attending different cases. I have used both intracapsular and extracapsular technics, depend-

ing upon the slit-lamp appearance of the lens, and with excellent results in every case.

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DISCUSSION

DR. HALL: Dr. Blaess, are all these descriptions based upon the appearance under the slit-lamp?

DR. BLAESS: This description is all, or practically all, based on the slit-lamp appearance. The first changes occur in the posterior sub-capsular

cortex as a clouding and translucency and, at the same time, there is a swelling occurring in the fibres. It's purely an autolitic problem. The lens fibres themselves, which constitute the individual cells of the lens, shrink a little, and the fluid, which was formerly the intracellular fluid, gathers between the fibres and in the main sutures. With the slit-lamp at this stage, we see the lamellar display and the splitting of the main sutures. The splitting of the main sutures is often so marked that you can notice it with oblique illumination or with an ophthalmoscope. I have seen cataracts in this stage, where the changes occurring first in the posterior cortex and then in the anterior cortex, where the clouding was so great that you couldn't see the fundus through those portions of the lens but you could still see it through these widened suture spaces where the fluid was still clear. As times goes on (as the lens fibres break down and the substance inside the cells is precipitated into this fluid) that fluid becomes milky and then loses its transparency. At the same time there is an intumescence going on in the whole lens. The lens becomes thicker and has a white milky appearance. There is practically no sclerosis and all the change is in the cortex. Vacuoles appear also under the anterior and posterior capsule, and in the anterior sub-capsular area they are the most easily visible with the slit-lamp. And at first you see that they have a white, foamy appearance, due to a multitude of small vacuoles or the different small vacuoles may later merge into one large vacuole and then the fibres themselves break down and then you get irregular fluid spaces with jagged borders between the lens fibres themselves; where the cell walls have broken down and leave large spaces. Then you get spicuals; you get that radiating spicual appearance or cuneiform type of radiation superimposed on a translucency of the whole thing; and the entire lens takes on a sort of a mother-of-pearl appearance, a sheen; which can be seen with the naked eye under oblique illumination.

DR. HUTCHINSON: Do you have any difficulty in getting the large lens through the pupillary aperture?

DR. BLAESS: We dilate the pupil ahead of time and usually the pupil and the iris is quite elastic. The problem is not so much getting the lens out through the pupil as it is in getting the lens zonule broken first. And we do that by rotating the lens after you have fastened it into the suction end-piece by vacuum. That was described by Felix LeGrange about two years ago. He described this method of breaking the zonule and I have been using it ever since, and there is no pressure as in the former method. We depended on counter-pressure and a traction on

the lens, to break the zonule either above or below and then tear it around. This way we tear the zonule without any pressure on the vitreous whatever. Simply rotate the lens in its own natural position, then when the lens is floating free in the patellar fossa, or on the anterior surface of the vitreous or the hyloid membrance, it's a very easy matter to lift it out through the pupil. The lens itself can give also. It is like a rubber sac or a balloon filled with water. It can be pulled through a very small space. The iris is elastic, so there is not much difficulty in getting it out through a round pupil. And, of course, with the other technique, the aspiration technique, it is very easy to go in with the aspirating tip and put the tip underneath the iris and aspirate.

DR. CRAWFORD: It would seem then that the necessary wait for cataracts to "ripen" is a thing of the past.

DR. BLAESS: We no longer need wait for cataracts to "ripen." We wait only until useful vision is lost and, as we know, useful vision in one individual is perhaps something different than useful vision in another individual. I operated on a mechanical engineer who was in danger of losing his income and his work; he had about twenty-one hundreths in each eye and I removed both cataracts intra-capsular for him. If a patient came in with that much vision, who was a day laborer or a housewife and could get along with that visual acuity, and didn't need it for their livelihood, we could probably wait until the vision went down a lot more or even perhaps try to retard the development of the cataract or arrest its development. Here we come to the point of what can be done to retard or arrest the development of the cataract. And there are various types of therapy. I have never seen a specific non-surgical cure for all types of cataract. I know of no method of curing cataract other than surgery. There are methods, however, of treating cataract and arresting and retarding the development of the opacification of the lens. I do not believe there is very much opposition to that view. It's generally accepted that in some cases, at least, you can retard or arrest the development of the cataract and in those cases it is probably a wise thing to do if the individual can get along with the amount of vision they have. It also depends on the factor of how much vision the patient has when first seen as to just what you should do for him. If the patient has twenty-thirtieths or twenty-fortieths or twenty-fiftieths vision, which is still useful vision, sometimes one can improve the efficiency of the retinal function with various types of photo-therapy. And also attempt some type of treatment to retard the development of the actual

opacification of the lens, I believe this is a wise procedure in those cases and certainly it has a profound and much better psychological reaction on the patient than the old type of management where they were told to wait until their cataracts got "ripe" and then have them operated. I have seen many patients who have waited for cataracts to ripen and have developed glaucoma or optic atrophy or some other complicating problem of the fundus. The patient is unable to distinguish between the loss of vision from his cataract and between the loss of vision from some condition affecting the nerve or fundus. I have seen such people wait until they have lost even all light perception and then come in and be all ready for an operation and expecting to have their sight restored. To be told that nothing can be done is very poor psychology in handling a patient. I believe that everything possible should be done, in suitable cases to retard or arrest the development of the cataract or to improve the retinal efficiency. Refraction changes very rapidly and they should have their refraction changed as frequent changes of lenses may be necessary to keep vision up. Maybe a change in two months in the lens will improve their vision by a line and a half or two which, aside from the actual benefit in sight they get, has a very profound psychological effect in the patient. They realize that their eyesight is being cared for and it's being kept up to a maximum and that there's possibility that they may retard or entirely arrest the development of that cataract and they know that somebody is working with them and that in itself, as I say, has a very profound psychological effect.

DR. GILBERT: What is the present status of the actual medical treatment of cataracts?

DR. BLAESS: There are various types of medications given, such as, the vitamine products and mineral products and also the injection of lens protein from pig lenses. However, what I said before I think still stands as far as medical literature is concerned and that is no one has absolutely cured cataract in any case with any type of treatment. Any treatment depends upon the etiological factors involved and we do not know, in some types of cataracts, what the actual causes are. In other types of cataracts, dinitrophenol, for example, we have a good idea and so the first thing is to eliminate the causative factor. I mean eliminate also focal infection and improve the nutrition of the individual. It is a matter of correcting their dietary habits as much as possible and there again the determination of a vitamine deficiency and of the particular vitamine is sometimes quite difficult. Of course we have photometric tests to determine

vitamine deficiency but it is a long procedure in adults. Nevertheless, I use vitamine concentrates almost always in incipient cases and carry out laboratory tests if any evidence of mineral deficiency is noted.

DR. CRAWFORD: What is your opinion of the efficacy of photo-therapy?

DR. BLAESS: I have seen many cases in which the vision has improved after the use of photo-therapy; I have examined a number of those cases before and after. I am cooperating with local optometrists at the present time. All incipient cataracts are referred to me. The pupils are dilated and a slit-lamp examination made. They are then given photo-therapy. The vision improves but we seldom see any change in the lens opacities, and the only answer we can give for that is that you're really improving the efficiency of retinal function. Every organ in the human body has a wide degree of reserve function. It's true of every organ. It is said, an individual can have one kidney and still lead a normal life with the one remaining kidney. That is because nature has endowed all of us with an excess of tissue function for each type of highly specialized tissue. That's true of the liver, it's true of the heart, it's even true of the muscles. Without exercise, we get soft and flabby but with a certain amount of exercise, calisthenics and physical effort we build up our muscular function and our muscles get hard and function more efficiently. The same is true of the retina. Normally the retina functions only to a certain degree of its efficiency but by stimulating the retina, with various types of photo-therapy, I believe it is possible to bring out some of that reserve retinal function. In other words, make the individual retina function more efficiently.

DR. KRASKIN: In your opinion, is there any control or therapeutic value in plus lens application or the application of absorptive lenses?

DR. BLAESS: I know very little about the control of opacification of the crystalline lens with eye glasses or lenses. Years ago it was observed that in most cataracts, the opacities developed more rapidly in the lower half of the lens and for that reason it is presumed that the lower part of the lens was subjected to more ultra-violet light; more sunlight. In other words, the upper part of the lens is shaded and over a long period of time, the lower half of the lens is subjected to more ultra-violet from daylight than the upper half. For that reason different types of absorption lenses were prescribed early enough, but after some of these changes have occurred it is doubtful whether in any case the absorption will have

much influence. They may retard or arrest the development of the cataract, however, we must recognize the fact that the development of a cataract or lens opacity itself is not a smooth, continuous or predictable process. It is a biological reaction and biological reactions are unpredictable. It is a living human tissue and sometimes without any treatment at all, for instance, we have seen lens opacities proceed very rapidly to a certain extent and then maybe stop and never develop any further. I have also seen cases where the opacification of the lens will proceed to a swelling of the lens and a splitting of the main suture lines and opacification of the edge of the fibres along the suture lines leaving a solid opacity, then the cells gradually returns to normal size and the lens returns to its normal size. We all have seen cases of retinitis pigmentosa associated with polar cataracts, anterior or posterior where the opacities will develop to a certain stage and then stop without any treatment whatsoever. So the opacification of a lens is itself unpredictable; we can not always tell whether our treatment is the thing that's influencing the lens or whether those changes are just taking place naturally in spite of what we are doing.

DR. GILBERT: Has any work been done with reference to allergy as the cause of cataract?

DR. BLAESS: There has been a great deal of work done and is still being done on allergy. There are different stages of the work on allergy. We know now, for instance, various types of allergy, and sensitization can produce marked inflammatory lesions of the retina and cornea. Allergic retinitis. I have actually seen these. That type of allergy may be due to a general food allergy, or a food or drug allergy, or any type of sensitization, plants, for example; or the same thing can happen from sensitizations to the protein of the individual's own lens. Gifford, the older Gifford, pointed out a good many years ago that, absorption of lens protein where the lens became intumescent and the protein of the lens fibres was broken down some individuals developed a very marked and persistent chorioretinitis. And that when the lens was removed it would quiet down and disappear. We know also, from our experience in intracapsular work, that we are avoiding inoculating the individual with the protein of his own lens, and thereby avoid many severe post-operative inflammations.

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THE WORK OF NEUMUELLER IN COMPUTING THE POWER OF THE CORRECTING CYLINDER IN CASES OF ASTIGMATISM

On several recent occasions in optometrical writings the Javal Rule has been mentioned. And not only mentioned, but seriously referred to as a vital factor in the evaluation of the findings of the ophthalmometer as these relate to the correction of corneal astigmatism. These references rather surprised us, as for some time we had felt that the excellent work done by Neumueller[1,2] in 1930 and 1933 had forever relegated

the Javal Rule into the limbo of things best forgotten. Particularly so, as the Neumueller reports were both given wide distribution in the pages of the AMERICAN JOURNAL OF OPTOMETRY and later in reprint form.

His published works on this subject were perhaps more seriously accepted in medical circles than they were in optometrical, as at least one[3] recent medical text dealing with refraction gives full credit to the work done by Neumueller and several other recent medical refractive texts[4,5] make use of his material on this subject and also make no mention of the long accepted Javal Rule.

For the sake of those optometrists who missed the precise significance of Neumueller's work when first published, and for those optometrists who have become subscribers since that time, we shall briefly review the entire matter, as the research of Neumueller in this field, plays an important part in proper refractive procedure.

First, let us restate the Javal Rule as accepted during the 40 year period from 1890 to 1930. According to Ryer[6], the rule read as follows. When correcting astigmatism with-the-rule, with minus cylinders, the ophthalmometric findings were multiplied by 1.25 and from this total was deducted 0.50 D. And when correcting astigmatism against-the-rule, with minus cylinders, the ophthalmometric finding was multiplied by 1.25 and to this total was added 0.50 D. This is restated in a somewhat different way by Neumueller[2], who presented the Javal Rule in this way: (1) read the ophthalmometer as to minus cylinder values. On account of the distance from the correcting cylinder to the anterior surface of the cornea, increase the amount of variation found with the instrument by 25 per cent, and then (2) because of physiological astigmatism, add —0.25 or —0.50 D. if the corneal astigmatism were against-the-rule, or add +0.25 or +0.50 D. if the corneal astigmatism were with-the-rule. Neumueller adds also that if the corneal astigmatism were at 45° or 135° the rule indicated that no physiological allowance was to be made. Such was the Javal Rule which was used for years to assist in interpreting the findings of the ophthalmometer.

In 1930, Neumueller[1] presented a series of five carefully prepared tables in which was presented, by his calculations, the difference between the correcting cylinder and the corneal astigmatism. These data revealed that the above difference was due to two factors, (a) the lens effectivity, of the total correcting lens, due to the distance between the lens and the anterior surface of the cornea, and (b) the prevailing ametropia which

in most cases at least accompanies the astigmatism. Neumueller points out that while the Javal Rule takes into consideration the first part [(a)], it failed to consider the second, and that his findings proved that the correcting cylinder will be more or less than the corneal astigmatic error, depending upon whether the first or second factor yields, by its magnitude, greater influence.

In other words, Neumueller found in 1930 as the result of his studies, that while the first part of the Javal Rule recognized the principle of lens effectivity, it did so only insofar as the cylindrical element of the lens was concerned and when this correcting cylinder was added to a spherical component, the combined lens value or effectivity frequently altered the power of the proper cylinder needed to correct the astigmatism which was present. In this manner serious question was raised as to the value of the first portion of the Javal Rule.

In 1933, Neumueller[2] presented data which indicated that the physiological allowance suggested in the second portion of the Javal Rule was also open to question. Neumueller's findings indicated in general that with a hyperopic spherical correction combined with a minus corneal astigmatism there is a tendency to decrease the power of the minus correcting cylinder. On the other hand, with a myopic spherical correction combined with a minus corneal astigmatism there is a tendency to increase the power of the minus correcting cylinder. Tables are presented which show physiological allowances at different age levels. Neumueller points out, however, that he is not proposing to make the determination of the correcting cylinder in corneal astigmatism the object of rule-of-thumb mathematical optical procedure.

Therefore the chief reasons given by Neumueller for the failure of the Javal Rule for computing astigmatic corrections are, (1) there is very little simple astigmatism. (2) Most cases of astigmatism are also either hyperopic or myopic. (3) The lens corrections are therefore combinations of spherical lenses and cylindrical lenses. (4) The Javal Rule fails to take into consideration the spherical element of the lens, which is shown to be very important particularly if it is stronger than the cylinder. (5) The failure of the Javal Rule to take also into consideration lenticular astigmatism. (6) The failure of the Javal rule to take also into consideration physiological astigmatism which increases with age.

Neumueller's tables show the effectivity of various sphero-cylindrical lens combinations when placed 15 mm. before the eye. A simplified method of expressing these combinations is found in the following table:

From plano to 2.00 D.Sph., allow 0.25 D. Cyl.
From 2.00 to 4.00 D.Sph., allow 0.50 D. Cyl.
From 4.00 to 6.00 D.Sph., allow 0.75 D. Cyl.

If the convex spherical component is greater than the cylindrical component, the above allowances in the cylindrical element are subtracted. If the concave spherical component is greater than the cylindrical component, the above allowances are added.

In addition to the foregoing physical allowances, an additional allowance must be made for the physiological astigmatism which exists within the eye and which Neumueller found to vary with age. This may be lenticular, but whatever its cause, it is here referred to as physiological astigmatism. It is usually against-the-rule in character and for the following ages has the following values:

From 1 to 30 years . . . . . 0.25 D. against-the-rule
From 31 to 60 years . . . . . 0.50 D. against-the-rule
From 60 years onward . . . . . 0.75 D. against-the-rule

These allowances for physiological astigmatism are to be subtracted when the corneal astigmatism is with-the-rule and added when it is against-the-rule.

From what has been reviewed of Neumueller's work, it is evident that in computing the proper cylindrical correction from the findings of the ophthalmometer, it is necessary to consider the lens effectivity of the sphero-cylinder to be used as well as the physiological astigmatism usually present at the age level of the patient. Neumueller presented to both the members of his own profession, as well as to the medical refractionists, much of lasting value in his research of a decade ago, the results of which have today, replaced to a very large degree, the use of the Javal Rule.

Carel C. Koch.

REFERENCES

[1]Neumueller, J. The effect of ametropia upon the correction for the corneal astigmatism. American Journal of Optometry. 7.4.201-212. 1930.

[2]Neumueller, J. The resultant correction cylinder of combined corneal astigmatism at oblique axis and physiological astigmatic allowance. American Journal of Optometry. 10.10.350-358. 1933.

[3]Maxwell, J. T. Outline of Ocular Refraction. Medical Publishing Company. Omaha, Nebr. 1937.

[4]Cowan, A. Refraction of the Eye. Lea & Febiger. Philadelphia, Penna. 1938.

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[6]Ryer, E. LeRoy. Ophthalmometry. The Optical Publishing Company. New York City. 1925.

PROCEDURE AND INSTRUMENTATION

by Guy L. DuPlessis

A department wherein discussions will be carried on relative to the value of various experimental and clinical techniques as employed by practicing optometrists, and also in which the instruments used by optometrists in various phases of their work, will be subjected to some critical evaluation.

PROJECTION SCREENS

Most screens now offered to the profession for projection of visual acuity characters are made in one size only. For special equipment layouts or experimental purposes special sized screens are often desired. The question of surface texture in making these special screens is often a problem. Silvered boards and papers have smooth texture but their direct and their angular reflectance differ so much that even small head movements make a considerable change in the contrast of the projected chart.

For the small characters used in visual acuity tests, it appears that a screen with smooth matt surface and with a high degree of reflectance is best. Masonite board makes an ideal base material for special sized screens because of its rigidity and workability. But the application of a proper aluminum finish to this is difficult.

We are advised by Morris[1] that a Fort Wayne finisher[2] has worked out a painting technique producing most satisfactory results. It appears that proper sanding is the secret of his success. A number of coats of aluminum are sprayed upon the masonite board. Each coat is then carefully sanded. The results are said to be all that could be desired.

[1]Morris, C. W., Utility Bldg., Fort Wayne, Ind.
[2]Feuchter, R., 522 Ewing St., Fort Wayne, Ind.

WIDE-FIELD BINOCULAR SLIT-LAMP

The *Bausch & Lomb Optical Company* announces the presentation of a new slit-lamp of new and more compact design, and possessing features permitting easier manipulation. The instrument combines a slit-lamp and a wide field binocular microscope for the examination of the cornea, aqueous and lens substance. Various forms of illumination can be obtained from the nitrogen light source. Their instrument is a modernization of the Gullstrand instrument.

HEAT ABSORBING LENSES IN HIGH MINUS

In general high myopes derive considerable comfort from lenses having marked absorptive properties in the infra-red end of the spectrum. Most of these heat absorbing lenses are green or dark green in color and their chief disadvantage in high minus corrections is the difference in thickness between the center and the periphery of the lens. This thickness difference results in marked unevenness in the absorption value and appearance of the finished lens.

The *American Optical Company* has remedied this objection by fusing together white ophthalmic glass and Calobar D glass. The contiguous surfaces are finished on +3.00 D. and —3.00 D. curves before fusing. The Calobar element is 3 mm. thick and the white lens element is 8 mm. thick. The fused rough blank is therefore 11 mm. thick. The front surface is then finished to a +3.00 D. spherical curve thereby leaving a uniform layer of Calobar D glass of plano power. The rear surface of the lens is then finished according to the prescription desired.

Weak cylinders may be ground in the front surface without materially changing the appearance of this lens or its absorption value. If strong cylinders are required, they should be ground onto the rear surface. By this method a strong minus lens of uniform color and absorptive value is produced with from 0.8 to 2 mm. of absorptive glass and the former cosmetic and optical objections are eliminated.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list, although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

1. OCULAR REFRACTION.

THE SUBJECTIVE TEST IN ANALYTICAL ROUTINE.

Sheridan, F. Associated Journal of Optometry, 1941, 6, 4, 14.

Sheridan points out that many other tests, in the Optometric Educational Programs refractive routine are effected by the lens power used as the No. 7 subjective finding. With this in mind he suggests that a visual standard should always be maintained relative to arriving at the subjective correction. This standard should be the lens values which just makes possible the reading of the 20/20 line on the Snellen chart. He points out that as a rule a weaker convex correction or a stronger concave correction will give better vision, but for the purposes of this test the subjective No. 7 finding should just bring the patient's distance visual acuity to normal.—C. C. K.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

by J. Fred Andreae, Secretary

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ACADEMY ACTIVITIES

Of course, when you read this, you will have made arrangements to attend the American Optometric Association Convention at Atlantic City, beginning Sunday, June 29.

Arrangements have been completed for an Academy Breakfast on Tuesday, July 1. The Executive Council will hold an executive meeting during the convention.

Fellows desiring to present papers at the Annual Meeting of the Academy in Chicago in December, 1941, are advised to so inform Fellow D. G. Hummel, 419 Guardian Building, Cleveland, Ohio, not later than August 15. The deadline for the acceptance of papers is October 1. Papers accepted for presentation must conform to adopted rules and regulations, and Dr. Hummel should be consulted before the papers are completed. Attention to this request will facilitate acceptance.

Optometrists desiring to make application for Fellowship in the Academy should not delay, as the required case records must be in hand sufficiently ahead of the date of the Annual Meeting in December to permit the Examination Committee to review and pass on them. Obviously, only so many records can be handled, and late applications will be held over until 1942.

Fellows who are interested may obtain the handsome gold Academy pin upon remittance to the Secretary of $3.50.

As you know, the publication of the YEAR BOOK was discontinued because the Yearly Transactions now appear in the JOURNAL. You may have noticed that the reading matter in the JOURNAL is so arranged as to permit removal for binding without the inclusion of extraneous matter. It is probable, in the course of time, that the YEAR BOOK editions will become difficult to obtain, and in this connection we call attention to the number on hand. Volumes 1, 5, 6, 7, 8, 9, 10, 11, 12, and 13 are available. The Executive Council has authorized their sale on the following basis:

Complete set, as enumerated - - -	$15.00
Five volumes, as selected - - - - -	10.00
Three volumes - - - - - - -	7.50
Single volume - - - - - - -	3.00

The Fellows in Los Angeles and environs have been quite active. A meeting was held on the evening of April 28 at the Clark Hotel in Los Angeles, and the following Fellows were present: Drs. Glenn Winslow, Ernest A. Hutchinson, Ralph Coops, Clarence Salter, Alvin Percival, O. M. Naranjo, William M. Kinney, Louis Jaques, Kenneth Jaques (Long Beach), and William M. Ketchum. Dr. Glenn Winslow, western member of the Executive Council, acted as temporary chairman, and Dr. William M. Ketchum acted as secretary, pro tem. It was unanimously decided to form a local chapter of the Academy. The next meeting will be held on May 26, at which time final arrangements governing the operation of the chapter will be consummated.

Current Comments by Carel C. Koch

A Monthly Department

in which the Editor of the AMERICAN JOURNAL OF OPTOMETRY & ARCHIVES OF THE AMERICAN ACADEMY OF OPTOMETRY will discuss items of news of general interest; such as relate to new instruments, clinical techniques, education, public health, and optometric legislative and organization problems.

PREVENTION OF NUTRITIONAL CATARACT WITH VITAMIN R.

Day[1] and his associates present evidence which indicates that nutritional cataract can be arrested by the use of vitamin R called riboflavin· also sometimes called vitamin G or vitamin B_2. According to Prebluda[2], vitamin R or riboflavin is a widely distributed growth vitamin. At one time it was thought that a lack of this vitamin was responsible for human pellagra, however recent studies have shown that the pellagra-preventing factor is distinct from riboflavin which is concerned with tissue and cell respiration. Riboflavin is water soluble, heat stable in acid or neutral solution and but rarely destroyed in an alkaline medium. Rich natural sources of riboflavin are beef liver, milk, eggs, prunes, spinach and turnip greens. Riboflavin has been demonstrated to increase vitality and to postpone senility in succeeding generations of experimental animals. However, there has been no specific disease in man reported to be due to a riboflavin deficiency with the exception of nutritional cataract.

A. O. A. AGAIN CONSIDERS PUBLIC RELATIONS PROGRAM

An American Optometric Association public relation program has been proposed by President Corbett. The program is devised to show the public what optometry really is—preferably by bringing the greatest number of optometrists into professional contact with the greatest number of patients. The program is based on the rendering by optometry of a genuine public service on a scientific and professional basis. This suggested public relations program is drawn with long-range objectives in mind. In the case of our profession such objectives must include con-

[1] Day, H. E. Arrest of Nutritional Cataract by use of Riboflavin. Journal of Nutrition. 15, 1-102. 1938.

[2] Prebluda, H. J. Composition and value of Foods. Handbook of Chemistry and Physics. 23rd Edition. Chemical Rubber Publishing Company, Cleveland, Ohio. 1939. pp. 1122-1123.

stant advance in standards of optometric education and professional practice. To be practical the program must involve the majority of optometrists in its execution, and must be financially capable of realization and must be based on the greatest direct return for the money spent.

In his proposal, President Corbett combines the present activities of the department of Public Health of the American Optometric Association and the proposed public relations program. The suggestions now made by him relative to his important matter will be considered by the delegates at the annual congress of the A. O. A. at Atlantic City.

UNDERGRADUATE OPTOMETRIC STUDENTS DEFERRED FOR MILITARY SERVICE

Undergraduate students of optometry are to be deferred for military service along with medical, dental and veterinary students, according to a statement made by Brigadier-General Lewis B. Hershey, National Director of Selective Service in Washington. General Hershey made this statement, and gave permission to announce this action to the profession. The statement was made to representatives of the Optometric Students Association and of the Public Health Bureau and the Department of National Affairs of the American Optometric Association who met with him. He stated that the optometric students were to be included in the memorandum of April 21, 1941, issued to draft boards in which he recommended such deferment for the medical and allied professional students because of authoritative information that shortages would exist in those professions if students were inducted for military service.

Although organized optometry and the student association have been permitted to issue this statement by the Selective Service Board, and assurances have been made that every consideration will be given for the deferment of students, in the meanwhile there will be no specific order for deferment until the issue is finally decided upon by the Office of Production Management. The Bureau of Labor Statistics of the Office of Production Management is now examining the brief submitted by the American Optometric Association which requests full and specific recommendation of deferment because of the shortage of qualified optometrists.

The Optometric Student Association is offering its services to all optometric students who are in doubt of their classification or whether or not they will be able to complete their studies. Inquiries should be

sent to the Optometric Student Association, c/o Public Health Bureau, 535 Fifth Avenue, New York City, immediately, giving all details of the case. Such inquiries will receive prompt attention.

REGISTRATION AND REGULATION OF OPTICAL DISPENSERS

Several months ago the writer[1] commented on the matter of registration for manufacturing and dispensing opticians, taking the position that such registration would be a mistake. In his comments the California opticians regulation act was referred to as the first of its kind in America. Dr. T. A. W. Elmgren, of Columbia, South Carolina, corrects this department by pointing out that an opticians clause in the optometry act of South Carolina enacted in 1917 was the first registration regulation for dispensing opticians in America. The optometrist, Elmgren, also points out that this clause regulating the activities of the optician in South Carolina has worked out very well indeed, as it permits a form of supervision of the qualities of materials used in the manufacture of glasses.

BOOK NOTICES AND REVIEWS

Books received are acknowledged by notices in this department. Special selections will be made for more extensive review in the interest of our readers as space permits.

Acknowledgment is hereby made of the receipt of the following books. As space permits these will be given additional detailed notices and in some cases these works will be subjected to future critical technical review.

TEXTBOOK OF OPHTHALMOLOGY. Sanford R. Gifford, M. D., F. A. C. S. Second Edition. Published by W. B. Saunders Company, West Washington Square, Philadelphia, Penna. 470 pages. 40 colored illustrations. 215 Regular illustrations. Cloth binding. $4.00. 1941.

FAMILY EXPENDITURES FOR MEDICAL CARE. Consumer Purchases Study. United States Department of Agriculture. Miscellaneous Publication No. 402. Published by the Superintendent of Documents, Washington, D. C. 241 pages. Paper covers. 30c. 1941.

NEURO-OPHTHALMOLOGY. R. Lindsay Rea, M. D., F. R. C. S. Second Edition. Published by the C. V. Mosby Company, 3523 Pine Blvd., St. Louis, Mo. 688 pages. 22 colored plates. 196 regular illustrations. Cloth binding. $13.50. 1941.

1941 YEAR BOOK OF THE NEW YORK STATE OPTOMETRIC ASSOCIATION. Published by the Association. D. K. Uttal, Editor, 2472 Broadway, New York City, 382 pages. Illustrated. Cloth binding. $2.00. 1941.

TEN YEARS OF OPTICAL DEVELOPMENTS. Published by the Riggs Optical Company. Garland Building. Chicago, Ill. Illustrated. Cloth binding. $2.00. 1941.

[1]Carel C. Koch. Licenses for Opticians. American Journal of Optometry and Archives of American Academy of Optometry, 18.4.199-200, 1941.

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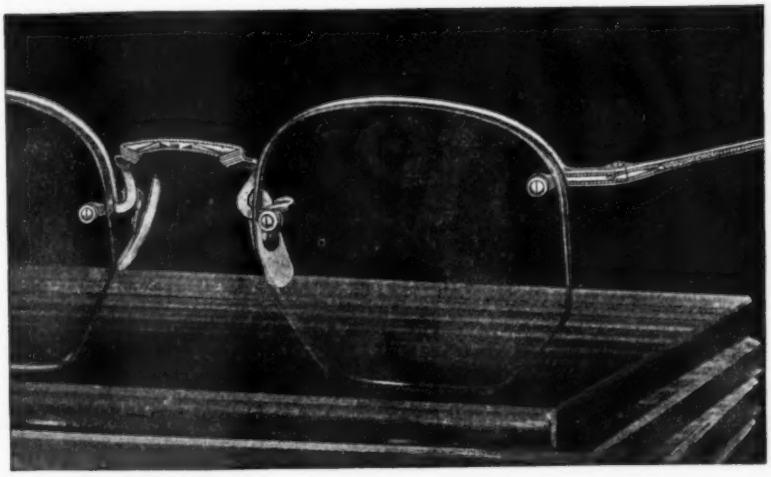

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Refraction showed only a change of a + .25 sphere indicated. New Rx made up in Soft-Lite. Week after receiving glasses patient phoned to report that lighting and glare did not bother him any more. Stated that new lenses were giving him greater comfort than he had ever believed possible. Once again the added neutral absorption of Soft-Lite Lenses resulted in a satisfied patient where none had been before. For better results, you too, prescribe Soft-Lite.

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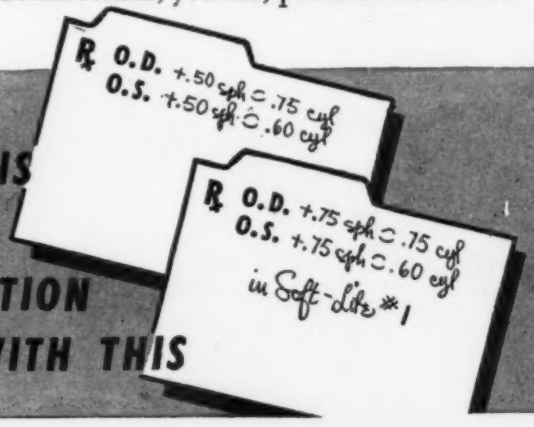

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